Airborne Observation Opportunities

NASA/Science Mission Directorate
Airborne Science Program

July 1, 2015

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Website: http://airbornescience.nasa.gov

SMD Suborbital Research Program

The SMD Suborbital Research Program powers scientific discovery, technological and educational investigations on suborbital vehicles through:

- *Conducting cutting edge Earth and Space science*
- *Calibration/validation of satellite measurements*
- *Developing technologies (science detectors and platforms) to improve Earth and space observation capabilities*
- *Promoting STEM through conducting exciting hands-on student training missions*

Suborbital Research Program is well-suited to:

- Quickly address new science phenomena
- Carry out significant science investigations at a fraction of the cost of a flight project
- Effective springboard for future spacecraft science missions
- Train next generation of researchers

Airborne Science Program

The NASA Airborne Science Program (ASP) within the Earth Science Division, provides NASA and commercial aircraft that benefit the earth science community. These manned and unmanned aircraft carry sensors that provide data to support and augment NASA spaceborne missions. The primary objectives of this program are:

- Conduct in-situ atmospheric measurements with varying resolutions
- Collect high-resolution imagery for process studies and sub-pixel resolution for spaceborne calibration
- Implement observational strategies for conducting earth science missions
- Demonstrate and exploit the capabilities of unmanned aerial systems (UAS) and autonomous aircraft for science investigations
- Test new sensor technologies in space-like environments
- Calibrate/validate space-based measurements and retrieval algorithms

- ***NASA's Airborne Science Program (ASP) conducts frequent global aircraft investigations in support of the NASA Earth Science community.***

- ***Altitudes: up to 21 km; Durations: up to 30 hr***
- Conduct an average of 17 missions/deployed field campaigns per year, utilizing more than 15 NASA aircraft and UASs.

Center Aircraft Offices

- ***SMD Airborne Science Program is implemented through NASA Aircraft Offices: ARC, AFRC, GSFC/WFF, GRC, JSC, and LaRC***

- Responsible for operation, maintenance, engineering, airworthiness, and mission support of assigned NASA and non-NASA aircraft/UAS as well as the planning and execution of Airborne Science missions for SMD.
- Provide logistical airlift needs, recovery operations, and a wide array of other aircraft functions.
- These Aircraft Offices operate aircraft on behalf of SMD worldwide.
- The knowledge and expertise of our personnel and aircrews, along with specific aircraft capabilities, allows SMD to support any type of mission requested by customers from commercial/military airfields to austere locations.
- The SMD Airborne Science Program is committed to safe, reliable, cost effective aircraft operations to support the NASA science community.

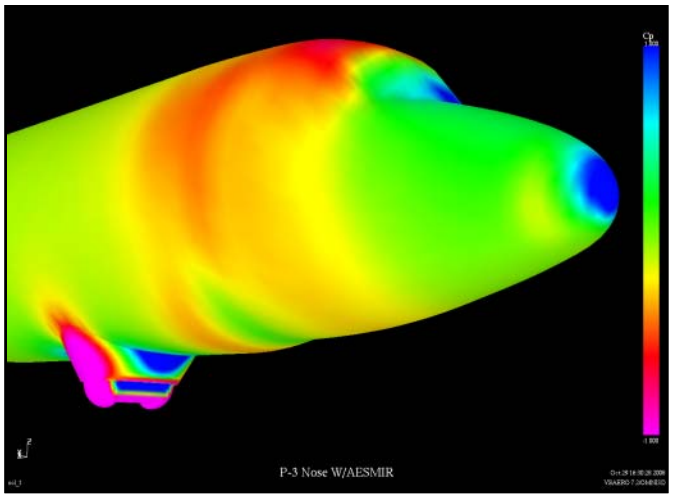
P-3 Orion

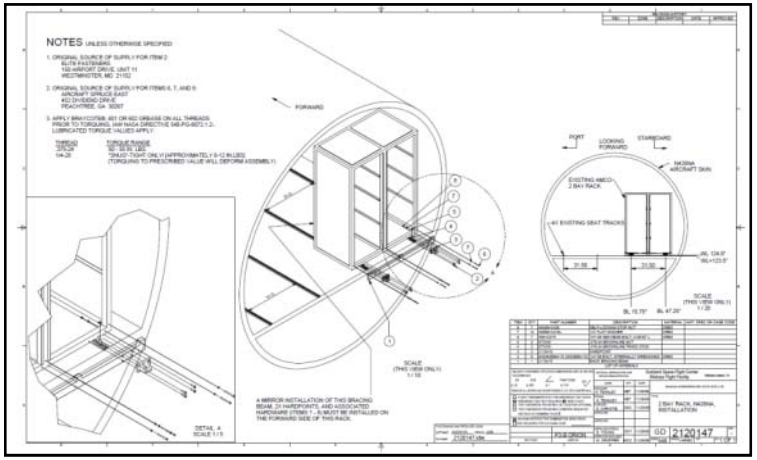
C-130 Hercules

DC-8

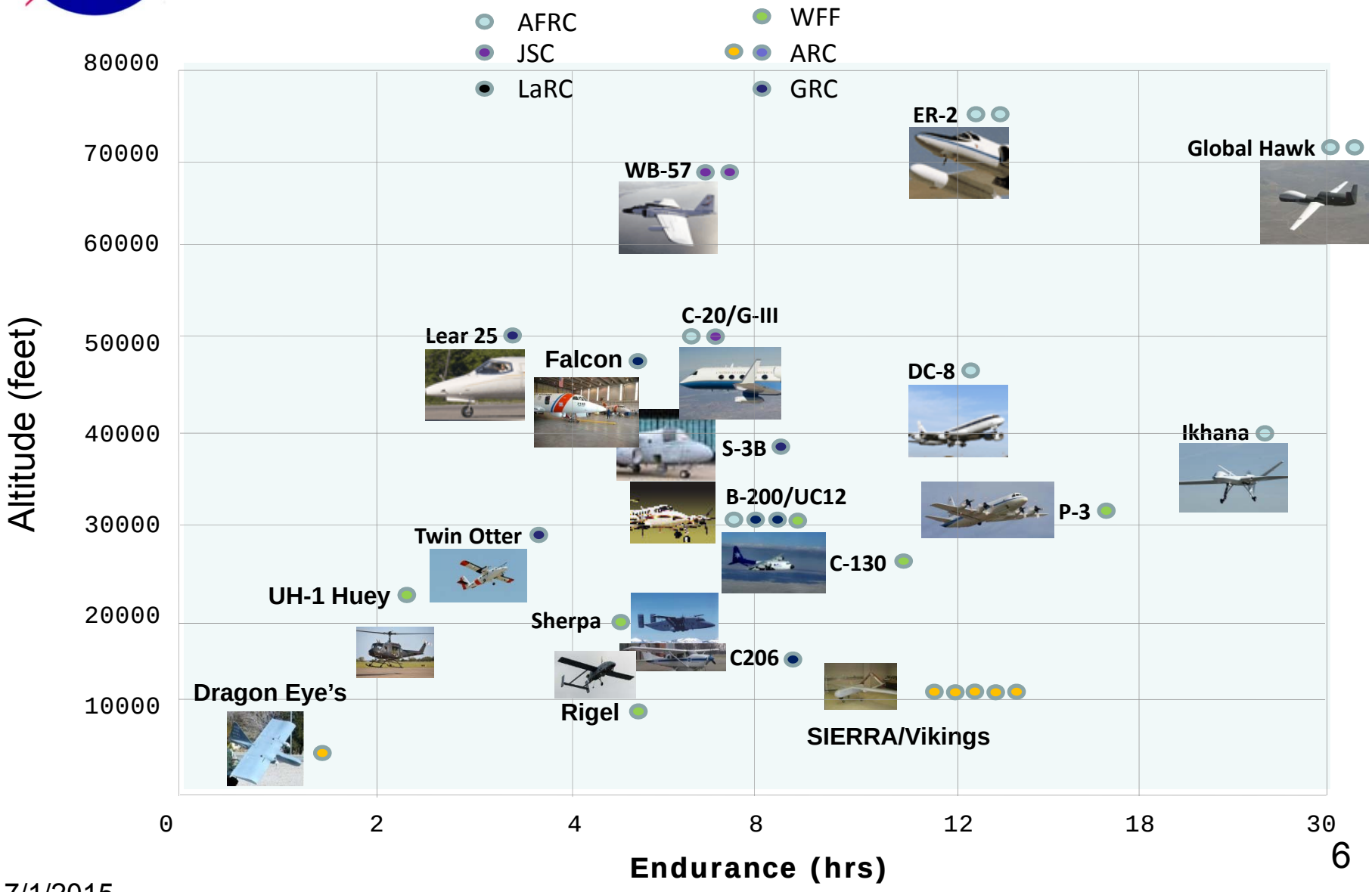
Center Aircraft Offices Aircraft Mission Support

- Mission Management
  - Logistics
  - Mission planning (cost, schedule, etc.)
  - Field support
  - Ground and flight safety support
- Engineering
  - Installation design and analysis
  - Upload and download support
- Airworthiness Oversight
- Maintenance Support
  - Assist with installation and removal of equipment from the aircraft





NASA Earth Science Research Capable Aircraft



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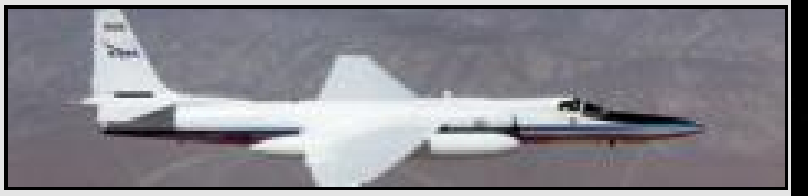
NASA Airborne Science Program
Core Aircraft

ASP Supported Aircraft

DC-8

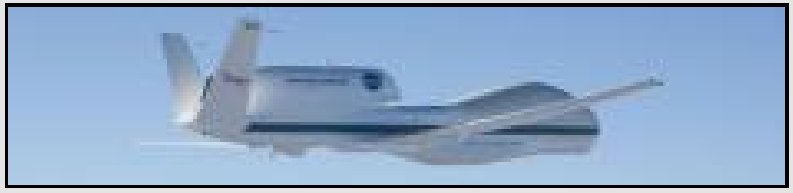
ER-2



G-III (C-20A) - Dryden

G-III - JSC

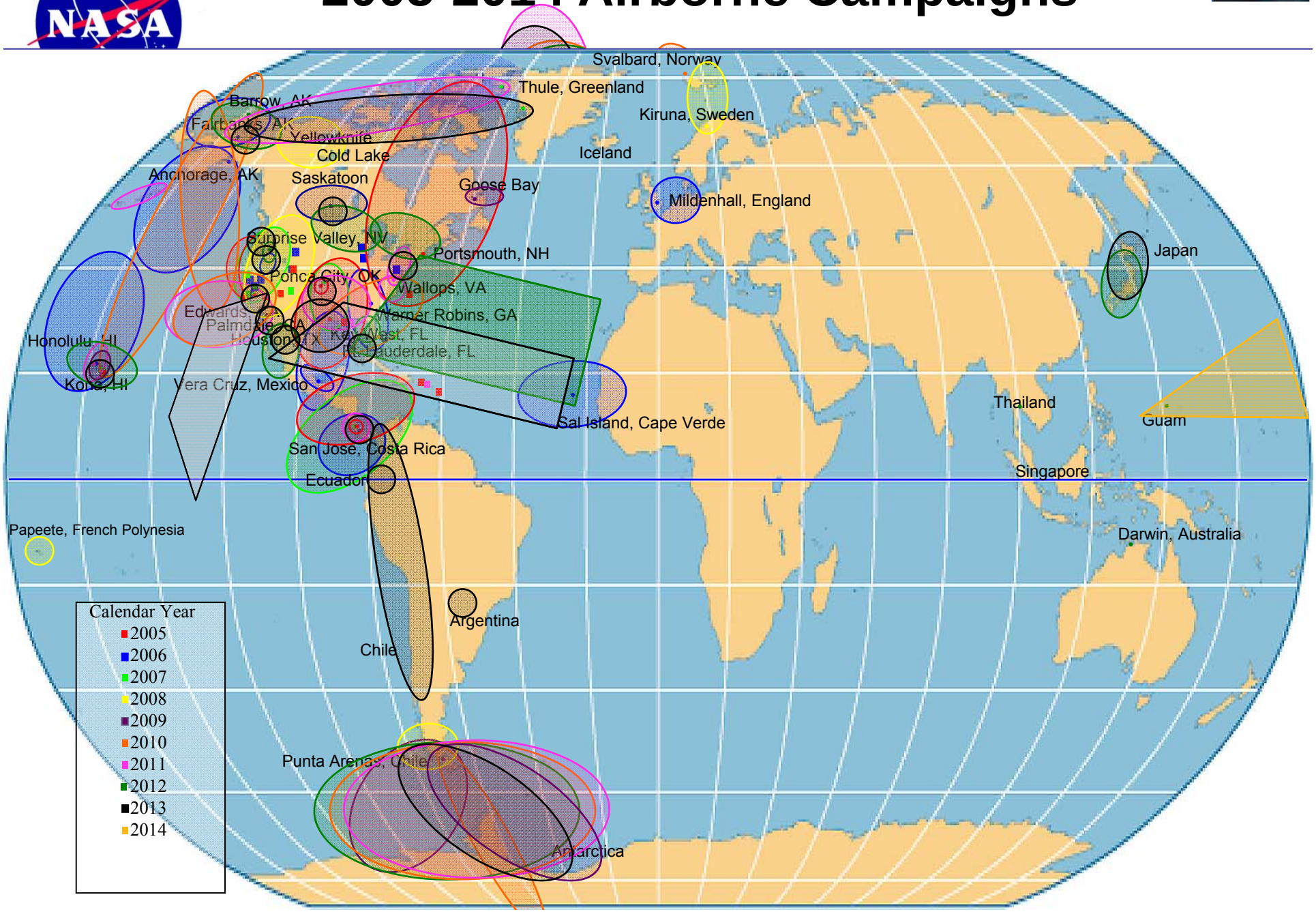
Global Hawk



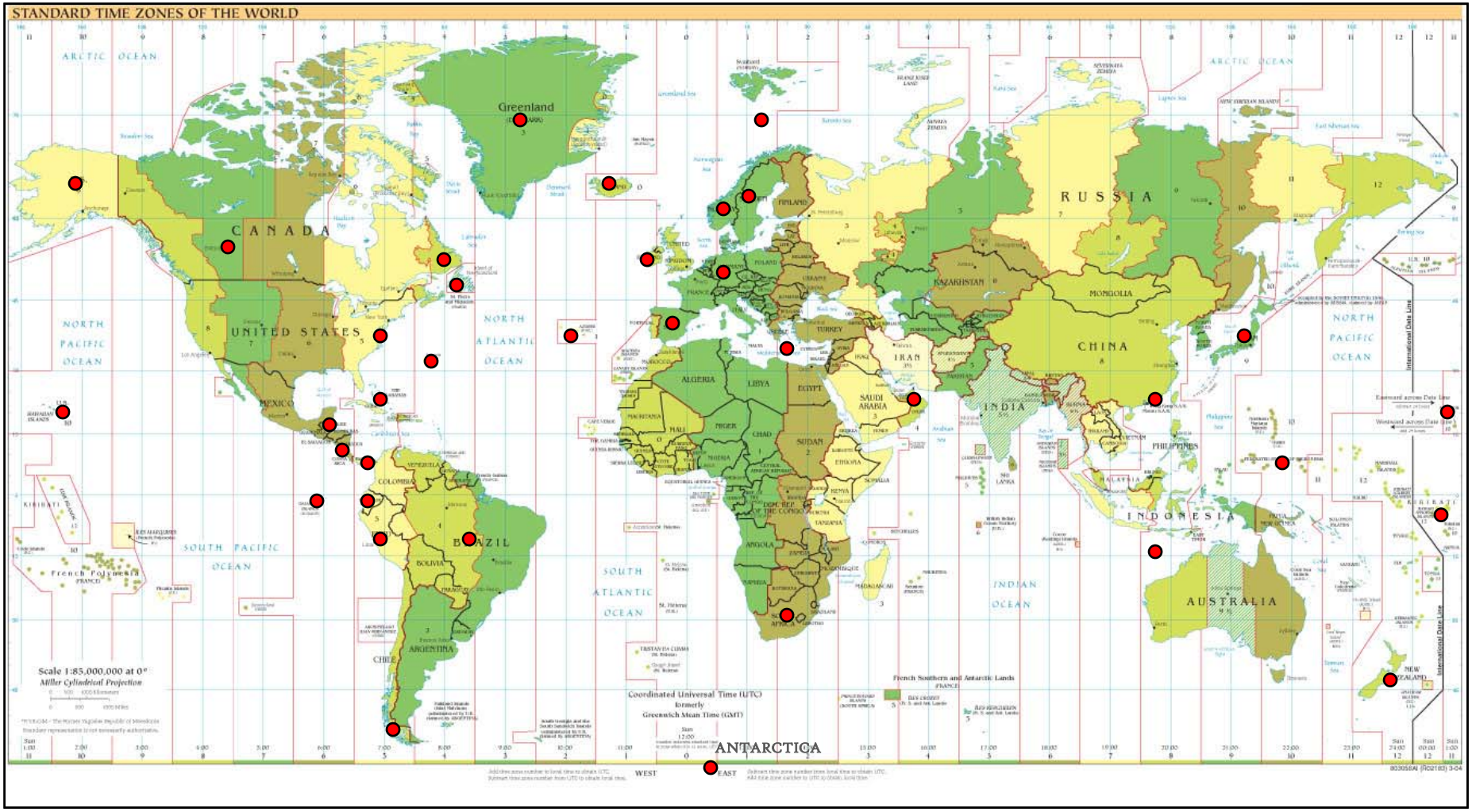
P-3 Orion

NASA Airborne Science Program
Other NASA Aircraft

2005-2014 Airborne Campaigns



Deployments Over the Years



NASA Aircraft Basic Specifications

NASA Aircraft Comparison

	Platform Name	Center	Duration (hours)	Useful Payload (lbs)	GTOW (lbs.)	Max Altitude (ft)	Air Speed (knots)	Range (Nmi)
ASP Supported Aircraft	DC-8	NASA - DFRC, UND	12.00	30,000	340,000	41,000 ft.	450	5,400
	ER-2	NASA - DFRC	12.00	2,900	40,000	70,000 ft	410	5,000
	G-III (C-20A) - Dryden	NASA-DFRC	7.00	2,500	69,700	45,000	460	3,400
	G-III - JSC	NASA - JSC	7.00	2,610	69,700	45,000	460	3,650
	Global Hawk	NASA - DFRC	30.00	1,900	25,600	65,000 ft	345	11,000
	P-3 Orion	NASA-WFF	14.00	14,700	135,000	32,000 MSL	400	3,800
	Platform Name	**Center**	**Duration (hours)**	**Useful Payload (lbs)**	**GTOW (lbs.)**	**Max Altitude (ft)**	**Air Speed (knots)**	**Range (Nmi)**
Other NASA Aircraft	B-200 (UC-12B) - LARC	NASA-LARC	6.20	4,100	13,500	31000 ft	260	1,250
	B-200 - DFRC	NASA - DFRC	6.00	1,850	12,500	30,000	272	1,490
	B-200 - LARC	NASA-LARC	6.20	4,100	13,500	35000 ft	260	1,250
	B-200 King Air - WFF	NASA - WFF	6.00	1,800	12,500	32,000 feet	275	1,800
	C-130 Hercules	NASA - WFF	10.00	36,500	155,000	33,000 ft.	290	1,050
	C-23 Sherpa	NASA-WFF	6.00	7,000	27,100	20,000 ft	190	1,000
	C-9B	NASA-JSC			110,000	37000	490	2,000
	Cessna 206H	NASA-LARC	5.70	1,175	3,600	15700 ft	150	700
	Dragon Eye	NASA Ames Research Center	1.00	1	6	500+	34	3
	HU-25C Falcon	NASA-LARC		3,000	32,000	42000	430	1,900
	Ikhana	NASA-DFRC	24.00	2,000	10,000	> 40,000 ft.	171	3,500
	Learjet 25	NASA - GRC	3.00	3,200	1,500	45,000 ft.	350	1,200
	S-3B	NASA-GRC	6.00	12,000	52,500	40000 ft	450	2,300
	SIERRA	NASA-ARC	10.00	100	400	12,000 ft.	60	600
	T-34C	NASA-GRC	3.00	500	4,400	25000 ft.	75	700
	Twin Otter - GRC	NASA-GRC	3.00	3,600	11,000	25,000	140	450
	UH-1 Huey	NASA WFF	2.00	3,880	9,040	12000	108	275
	WB-57	NASA - JSC	6.50	8,800	72,000	60,000 ft and above (payload dependent)	410	2,500
	XSCAV	NASA-ARC	4.00	50	130		30	

P-3 Orion Aircraft – N426NA

P-3 Orion Description:

Four T56-A-14 turboprop engines

Extensively modified for NASA science use:

- Two bomb bay ports, Nose radome port, Tailcone port
- One 16” dia. zenith port
- Three nadir ports
- Wing mounts
- Four P-3 bubble and three DC-8 passenger windows

115V 60Hz and 400Hz power along with 28VDC

Lavatory and galley on board

Max altitude: 30,000 feet; Max airspeed: 400 KTAS

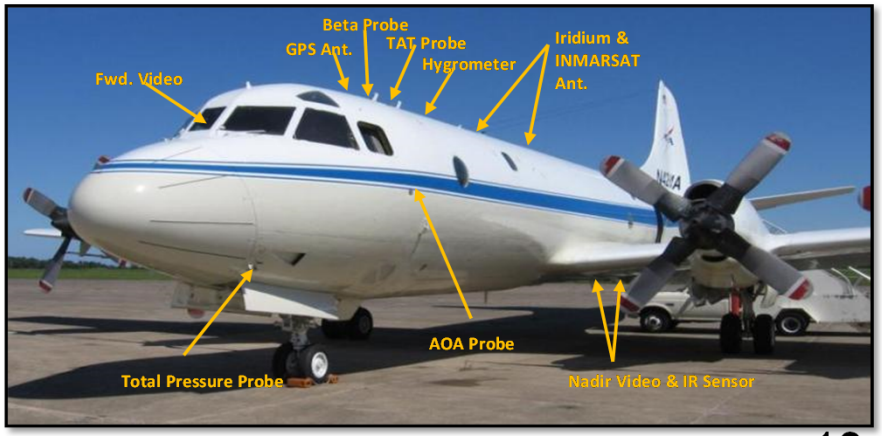
Max endurance time: 14 hours (~3,800 miles)

Minimum runway length: 7,000 feet

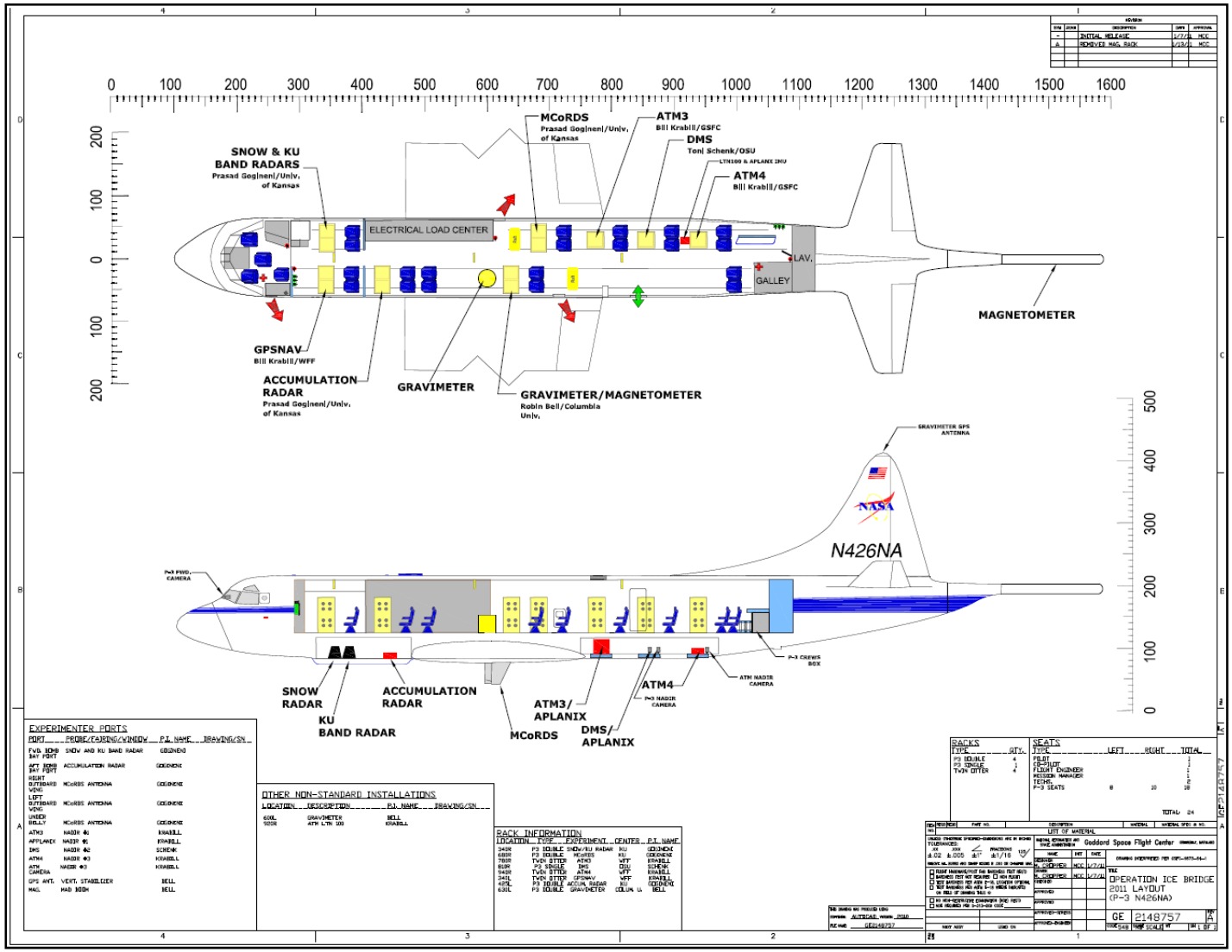
Payload capacity: ~14,700 lbs

Airborne Data System

- REVEAL/NASDAT system operated by UND (same system as on DC-8)
- Recording of aircraft parameters and facility instrumentation data via ARINC 429, MIL-STD-1553, analog channels and network inputs
- Recording of experimenter data via analog channels, RS-232, network inputs and video feeds
- Redundant, reliable data storage
- Retransmission of data within the aircraft via RS-232 and Ethernet to onboard instrumentation
- Transmission of data to and from the ground and other aircraft in real time via satellite communications
- High-performance time services
- Real-time text-based chat
- Web-based situations awareness displays



P-3 – Typical Mission Layout



Typical Aircraft Modifications

DC-8

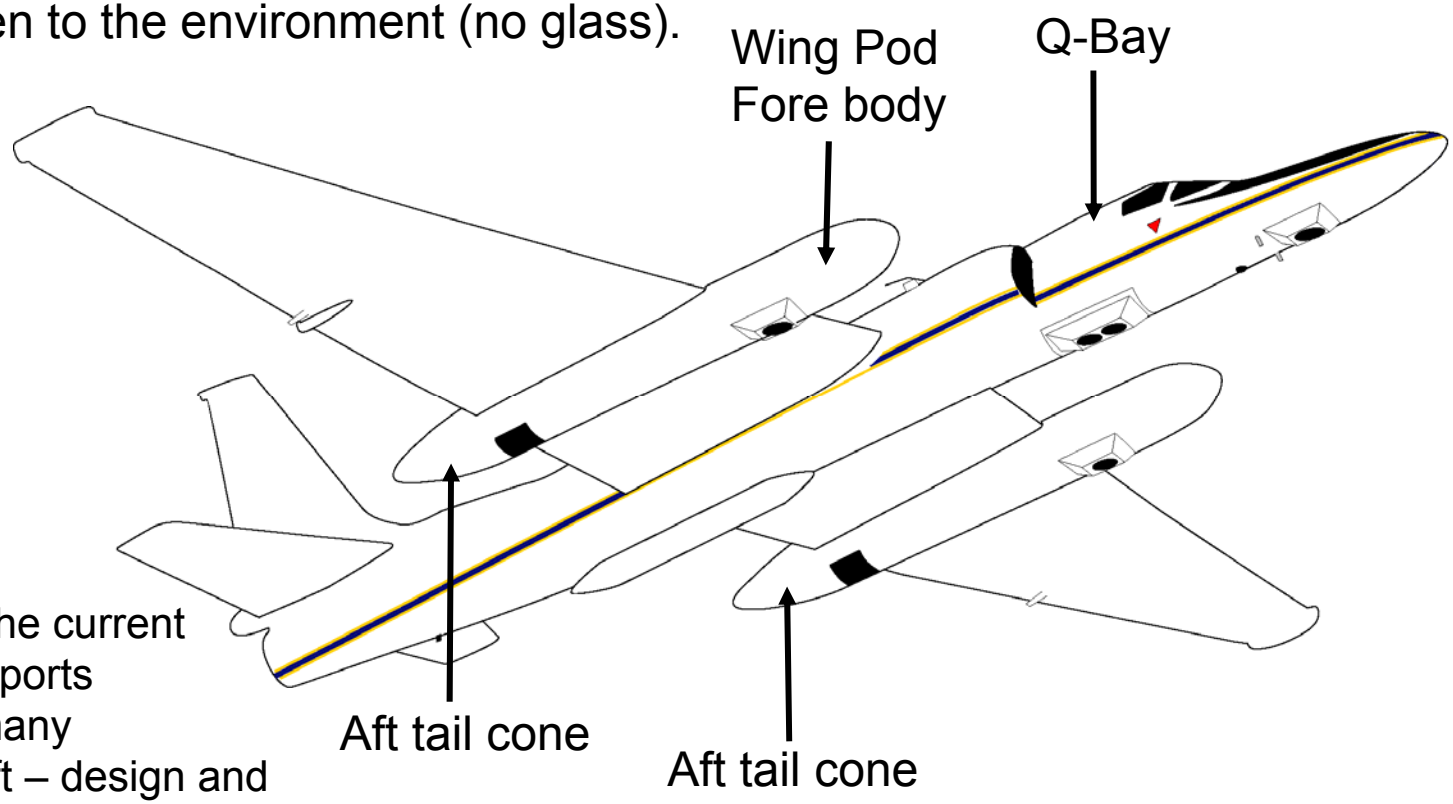
- The DC-8 Flying Laboratory is a uniquely capable asset supporting NASA Earth science missions.
- Altitude: 41,000 ft
- Payload: 30,000 lbs
- Range: 5,400 nmi

- 1 Zenith View Port 16”x18”
- 13 Modified Window Frames 16”x18”
- 4 Zenith 62^0 View Ports 16”x21”
- 2 Nadir View Ports 37”x30”
- 3 Nadir View Ports 16”x21”
- 1 Nadir Camera Port
- 9 Optical Window Shutters
- Wing Tip Pylons/Pods
- Dropsonde Port/Launcher Tube
- Wing Root Radome Panels
- Removable Weather Radar Antenna
- 1 INMARSAT Antenna
- MMS 102 TAT Sensor Installation Locations
- 12 Channel IRIDIUM & GPS Antenna Farm
- Standard 19” rack mounting provisions in cabin and cargo spaces

ER-2

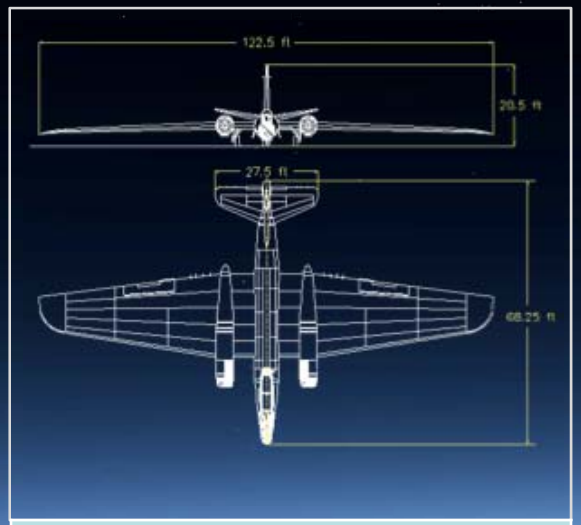
- 3 Zenith ports are currently available in the Q-bay
- 2 of 4 Aft tail cones have zenith openings* that can be customized
- 1 of 4 Forebody wing pods have openings* that can be customized

*Openings are not considered “ports” since they are open to the environment (no glass).

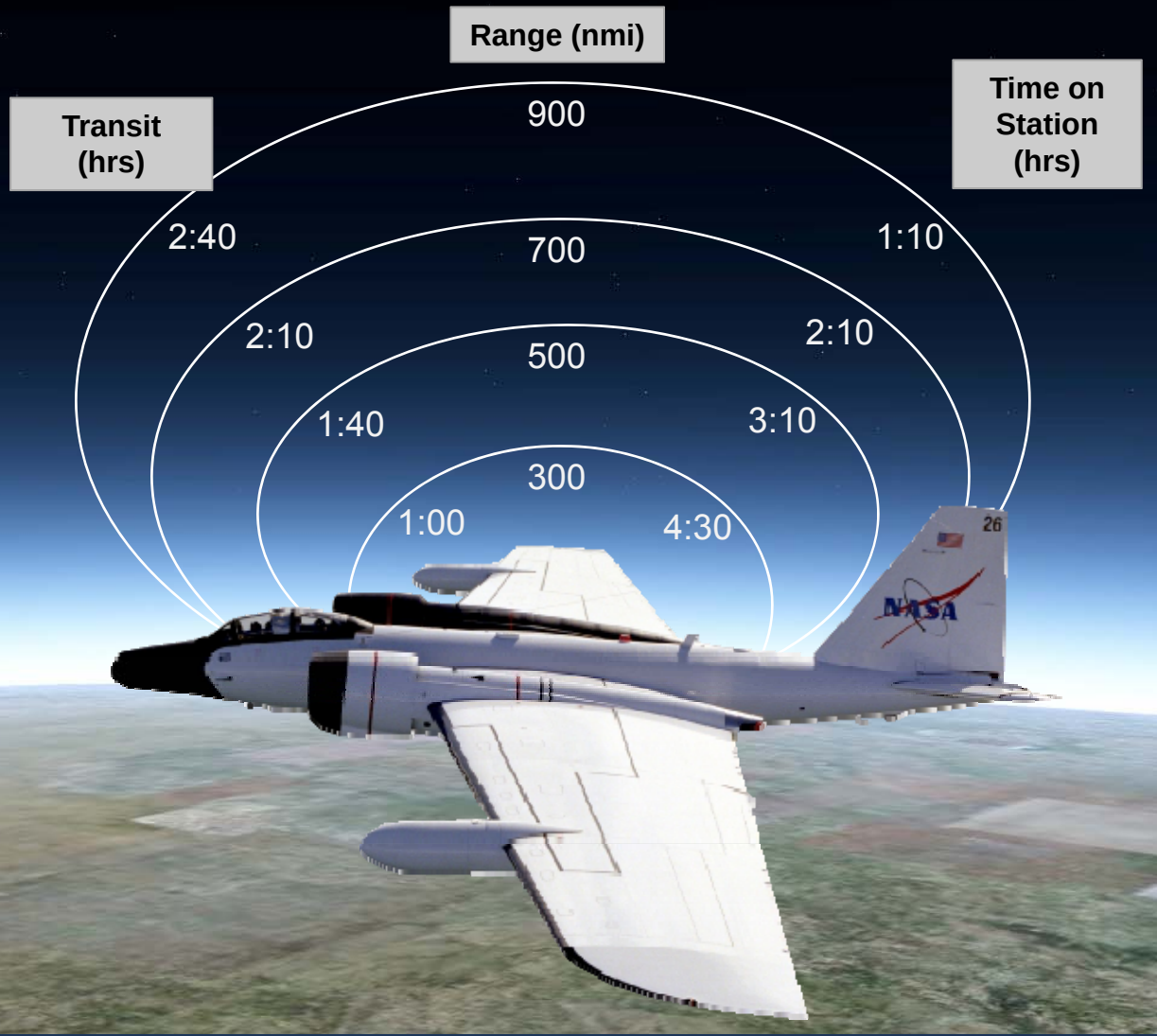


This graphic displays the current configuration. Custom ports can be configured in many locations on the aircraft – design and fabrication cost/schedule apply

WB-57: Capable



PERFORMANCE	
Aircraft ceiling	60,000+ feet
Endurance	6.5 hours
Range	2,500 miles
Max. payload	8,800 pounds
Airspeed @ 60kft	410 knots (Max: Mach 0.8)
Aircrew	2
Wingspan	123 feet



WB-57: Adaptable

TAILORED SENSOR SOLUTIONS

- Unique access to cutting-edge technologies across NASA / DoD / national agencies not currently available through existing service or industry platforms.
- No "standard payload" constraints.
- Sensor package(s) compiled to meet each mission's requirements.
- Platform capable of integrating, testing and employing customer sensors.
- Multiple air-to-ground communication options: Voice, BLOS & LOS datalinks.
- Multiple payload power options: 110V 400Hz, 110V 60Hz, & 28VDC.

SENSOR INTEGRATION OPTIONS

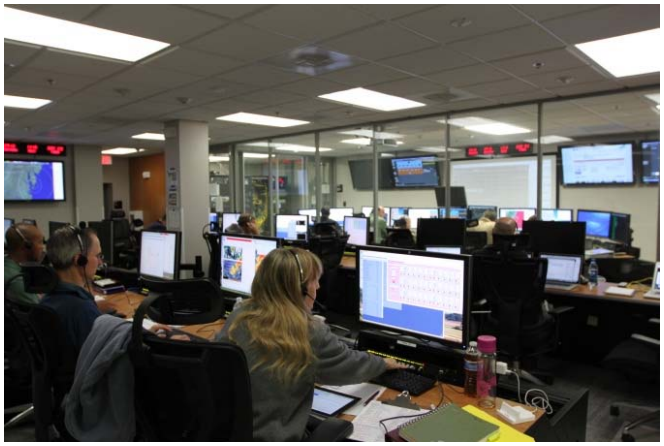
A	Reconfigurable/removable, pressurized nose cone
B	4 hard points 2/wing; compatible with ER-2 SPEAR Pod, Super Pod and BRU's;
C	12' bomb bay (3 'or 6' Universal Pallet System); 1000lb capacity per 3' space
D	20x small sensor hatches; ten hatches per wing
E	Tail cone / upper equipment bay

Global Hawk

- NASA maintains 2 Global Hawk UAS specifically targeted to support SMD science operations.
- The Global Hawk Operations Center – provides command and control for the AFRC Global Hawk aircraft (located at AFRC and GSFC/WFF). This center acts as a primary operating location for Global Hawk flight crews and experimenters flying experiments around the world or as a backup center the west coast

Global Hawk UAS

Endurance	24-26 hours for Typical Missions 28.6 hours Demonstrated
Range	10,000 nmi
Service Ceiling	65,000 ft, < 50% available A/C payload power 62,500 ft, > 50% available A/C payload power
Airspeed (55,000+ ft)	335 KTAS
Payload	1,200 lb Demonstrated
Length	44 ft
Wingspan	116 ft



GSFC/WFF Global Hawk Operations Center

C-130 Hercules – N439NA

C-130 Hercules Description:

- Former USAF cargo aircraft
- Four T56-A-15 turboprop engines
- Aircraft features:
  - Aft cargo ramp (opens outward and inward)
  - Elongated nose with nadir port
  - 55” dia. nadir port
  - Large side removable fuselage plug
  - 120V 60Hz and 400 Hz experimenter power available along with 28VDC
  - Extra air conditioning for high heat loads
- Max altitude: 33,000 feet
- Max airspeed: 320 knots
- Max endurance time: 8-10 hours
- Max. range: 3,200 nmi.
- Minimum runway length: 1,400 to 3,500 feet
- Payload capacity: 45,000 lbs

Payload in C-130

B-200 King Air – N8NA

- **B-200 Description:**
  - Passenger style tubroprop business aircraft
  - Wing span: 54 feet 6 inches
  - Length: 43 feet 9 inches
  - Height: 15 feet
  - Two PT6A-42 turboprop engines
  - Ports available for NASA science use:
    - 8 non-removable windows
    - GPS/Iridium experimenter antennas installed
  - 28VDC experimenter power
  - Max altitude: 32,000 feet
  - Max airspeed: 275 KTAS
  - Max endurance time: 6 hours (~1,800 miles)
  - Payload capacity: ~1,800 lbs
  - Max crew: 10 persons
  - Due FAA standard certificate to conduct passenger flights this aircraft can not be modified for science except for reconfiguring the cabin to utilizing the existing window.

B-200 King Air

Airborne Support for Sounding Rockets Missions

- **November 2014 – Norway/Andoya Space Center Campaign**
  - The C-REX mission launched on a four-stage Talos-Terrier-Brant-Nihka (Black Brant XII) to a projected altitude of 328 miles carrying the Cusp-Region Experiment (C-REX) payload.
  - 24 sub-payloads were ejected from the rocket as it flew to nearly 302 miles altitude.
  - Ground–based cameras and those on a *NASA King Air B-200 aircraft* tracked the tracers.
  - The science team gathered data of the vapor cloud releases, using ground cameras and cameras flown aboard the NASA B200 aircraft.

C-23 Sherpa Aircraft – N430NA

C-23 Sherpa Description:

- Former Army National Guard logistics aircraft
- Wing span: 74 feet 10 inches
- Length: 58 feet 1 inches
- Height: 16 feet 5 inches
- Two PT6A-65AR turboprop engines
- Aircraft features
  - Aft cargo ramp (opens outward and inward)
  - Nose cargo opening (holds 400lbs)
  - 22 removable passenger windows
  - Large port cargo door
  - 28VDC converted to 115VAC
  - Unpressurized, passenger O2 available
  - Lavatory available
- Max altitude: 20,000 feet
- Max airspeed: 196 KIAS
- Max endurance time: 6.5 hours (~1,800 miles) w/aux tanks
- Minimum runway length: 3,000 feet
- Payload capacity: ~7,000 lbs
- Max crew: 10 persons

Science Operations Flight Request System (SOFRS)

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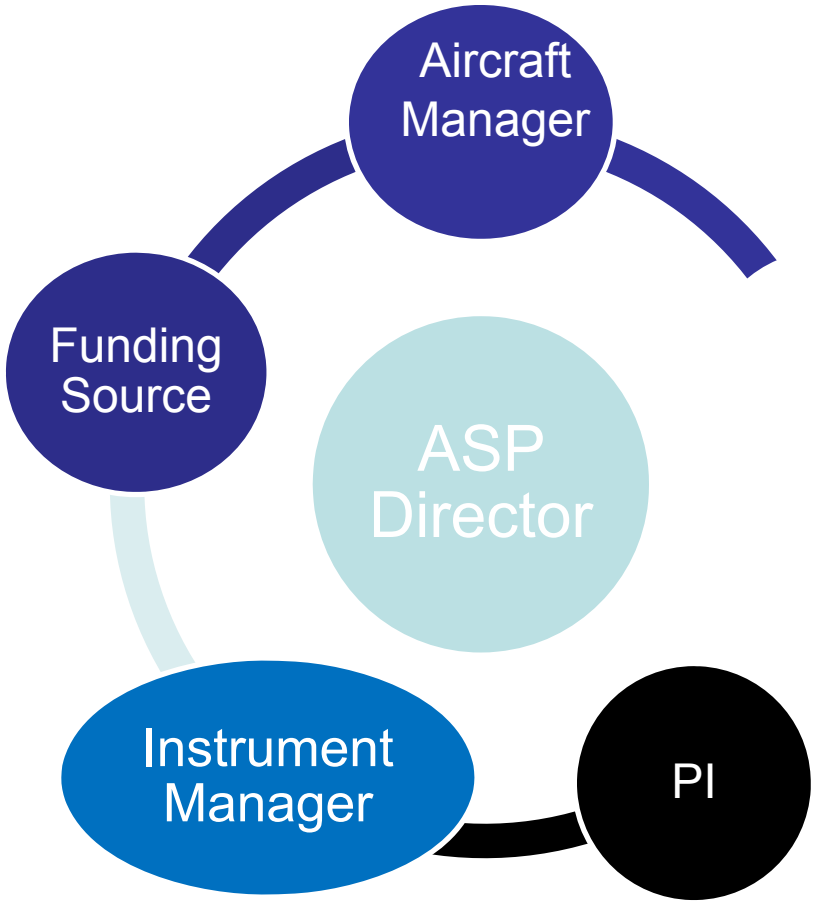
https://airbornescience.nasa.gov

Science Operations Flight Request System (SOFRS)

Science Flight Planning Communication and Reporting Tool



300+ different instruments

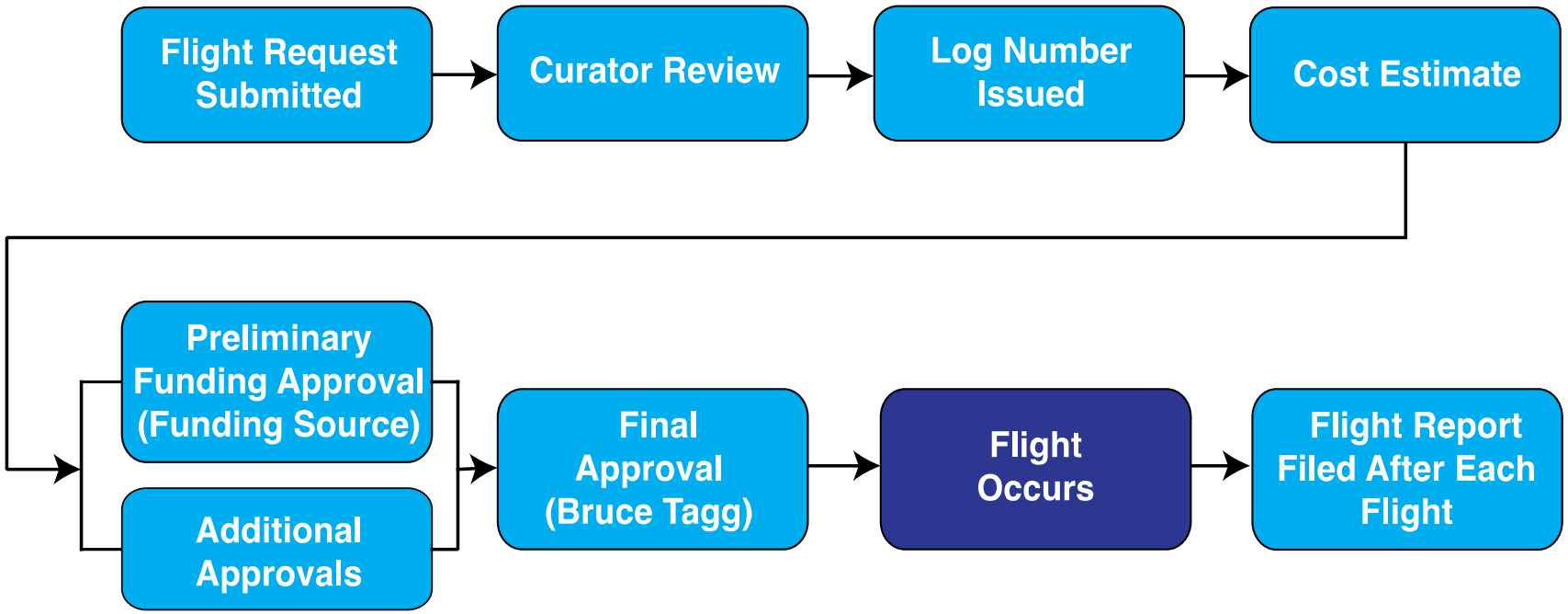
50+ different aircraft

4,600+ annual science flight hours

27 different reports

Science Operations Flight Request System (SOFRS)

ASP Flight Request (FR)Approval Process



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- Flight Request

Documents

- Airborne Science Program Spring 2015 newsletter
- ASP FY15 Call Letter Rev 2
- Airborne Science Program 2014 Annual Report

More Documents

News

NASA ER-2 Completes Suomi-NPP Arctic Validation Mission

NASA's high-altitude ER-2 aircraft completed a series of validation flights last month in support of the Earth-observing NASA/NOAA Suomi National Po...

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About the Airborne Science Program

The Airborne Science Program within the Earth Science Division is responsible for providing aircraft systems that further science and advance the use of satellite data. The primary objectives of this program are to:

- **Satellite Calibration and Validation**

Current Activities

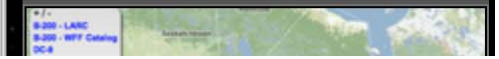
Operation IceBridge

Visit Mission Website

- Airborne Surface Water and Ocean Topography (AirSW...
- G-III UAVSAR

More Current Activities

Asset Tracker



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News

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NA… Airborne …ience Program

Home > Science Operations Flight Request System (SOFRS)

Science Operations Flight Request System (SOFRS)

Accessing NASA Airborne Science Platforms and Instruments

The Airborne Science Program (ASP) maintains aircraft and sensor assets to support the Science Mission Directorate (SMD). The Science Operations Flight Request System (SOFRS) manages and tracks the allocation of the ASP aircraft and facility sensors. The aircraft (platform) as well as facility sensor (instrumentation) information is accessible through the Airborne Science Program website.

Requests for scheduling these assets shall be submitted through S…S. This system was designed to allow researchers to have access to unique NASA aircraft, as well as some comm… …ircraft with which NASA has made contracting arrangements.

The only way to schedule the use of NASA SMD platf… …nd instrument assets is to submit a Flight Request through SOFRS.

Step by step instructions for submitting a Flight Request are at this link:
HOW TO SUBMIT A FLIGHT REQUEST

User Fees

The assets of the program are available on a fee-for-service basis, although, because the SMD maintains a base capability, only the marginal cost of the actual missions are borne by experiments given NASA HQ science concurrence. User fees are based on the flight hour cost (e.g. pilots, in-flight engineer, fuel, etc..), mission-specific costs (engineering and deployment costs) and any ancillary support costs (satellite communication requirements, facility instrument data and operations costs).

Airborne Science Program Contact

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https://airbornescience.nasa.gov